R-009-205.2

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GROUNDWATER MODELING AND GEOCHEMICAL INVESTIGATION SUGGESTED RELOCATION OF THE SOUTH PLUME WELL FIELD MAY, 1991

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GROUNDWATER MODELING AND GEOCHEMICAL INVESTIGATION

SUGGESTED RELOCATION OF THE SOUTH PLUME WELL FIELD

Prepared by
ASI/IT

May, 1991

DETAILED INVESTIGATION FOR SOUTH PLUME REMOVAL ACTION WELLS

Introduction

The fundamental objective of the removal action for the south plume is to protect public health by limiting access to and use of groundwater with uranium concentrations exceeding the derived concentration limit of 30 µg/L for uranium in drinking water. Secondary objectives of the removal action are to protect the groundwater environment of the sole source aquifer and control the plume to prevent migration to additional receptors to the south.

The selected conceptual design for the removal action was to install three to five wells in the vicinity of New Haven Road to intercept the plume. The exact number and location of these wells were to be determined by exploratory drilling and sampling to verify the location and extent of the plume exceeding the 30 µg/L limit. The recovery wells were to be screened over the top 40 feet of the aquifer and provide a combined pumping rate of 1500 to 2500 gpm. This conceptual well field was designed to intercept the plume while not reversing the aquifer flow south of the well field.

The removal action pumping program was designed to discharge water directly to the Great Miami River without treatment. An equivalent mass of uranium will be removed from the FMPC discharge so that there is no net increase in uranium being directed to the river. The lack of a treatment system means that the pumped water must be of relatively good quality except for the uranium content.

The purpose of this work plan addendum is to present a summary of the current data and the necessary steps required to determine the optimum location of the removal action wells. This will require field sampling, data analysis and computer modeling of flow and particle tracking. The proposed actions are the result of an analysis of the data and numerous discussions with WMCO, DOE and Paddys Run Road Site (PRRS) staffs.

Data Summary

There has been only one sampling period in which a large number of wells and piezometers within the south plume area were sampled over a relatively short period of time. This was the first quarter of 1990. These samples indicate a wide area exists where total uranium values are between 10 and 30 µg/L, as shown in Figure 1. Figure 1 also indicates the extent of the glacial overburden. In most of the south plume area there is no glacial overburden. In the area where the glacial overburden is absent, the surface material is alluvium from a time when the Great Miami River meandered over this area. Under the alluvium is the sand and gravel of the Great Miami Aquifer. Figure 1 includes all wells installed by the PRRS RI/FS and piezometers and wells installed by the PRRS RI/FS. Figure 1 contains the total uranium values from samples collected during the first quarter of 1990 under both RI/FS efforts. The Fernald RI/FS collected samples under the 51 well sampling program and from wells as they were installed under the 10 well and 31 well installation programs. The Fernald RI/FS also sampled the PRRS piezometers for total uranium. The PRRS RI/FS sampled all the wells they had installed. Wells in Figure 1 which do not have a uranium value next to them have been installed and sampled by either the Fernald or PRRS RI/FS since the end of the first quarter of 1990.

Figure 1 is a one-time definition of the extent of uranium contamination in the area. Quarterly monitoring in other parts of the site indicate that uranium values can vary over wide ranges from quarter to quarter; therefore, this one-time sampling of the area may not be an accurate representation of the plume under all seasonal conditions. This variability has shown up in Wells 2391 and 3391 located near the intersection of New Haven Road and Highway 128 in the area thought to be the leading edge of the south plume. Uranium values in samples collected in April and June from Well 2391 had 14.5 and 3.5 μg/L respectively. Samples collected in May and July from Well 3391 had <1, and 7 μg/L. Duplicate samples from Well 3391 collected in August had 7 and 10 μg/L total uranium. This one-time sampling shown in Figure 1 is, however, consistent with the groundwater model prediction of the plume presented in the RI/FS Groundwater Report.

Contamination other than Uranium

The PRRS data for samples collected in May and July 1990 indicate that there is a significant inorganic plume from the area of the Albright & Wilson Plant and organic chemicals in a plume in the area of Ruetgers-Nease. As presented in the RI/FS Groundwater Report, there is an apparent groundwater quality signature of inorganic chemicals in the plume from the PRRS site. As shown in Table 1, Well 2094 located downgradient of the PRRS site contains levels of inorganic parameters above the average values for all the FMPC RI/FS 2000-series wells. Table 1 includes average values from PRRS samples collected in May and July 1990 from Wells 2626, 2636, and 3636, which are located on the east side of the Albright & Wilson property. As is shown clearly in Table 1, all of the signature parameters are found in Wells 2626 and 2636 at levels above the average in the FMPC RI/FS and most of those in Well 2094. Even PRRS Well 3636 shows elevated levels of iron and barium.

The average conductance for samples from Well 2094 is 1341 μmohs/cm, while the overall average is 576 μmohs/cm. We do not have data on conductance from the PRRS samples; however, it is clear 3

TABLE 1

Inorganic PRRS Plume Signature (mg/ℓ)

Parameter	Ba	Fe	Mg	K	Na	Cl	Total Phosphorus
Well							
2094	1.133	17.948	49.23	199.83	69.53	144.75	2.57
FMPC Average	0.128	1.749	25.85	13.07	14.22	31.55	0.6
2626	2.4	40.25	33.65	420.00	662.5	38.5	257.0
2636	2.2	117.50	52.15	266.50	313	570.0	22.36
3636	88.0	1835.0	24.90	4.20	16.2	26.0	1.35

TABLE 2

Average Concentrations May and July μg/ℓ

Well	2629	2630	2631	2632	2633	2634
Ethylbenzene	8,550	123,000	17,000	21,000	3,850	1,150
Toluene	19,950	215,000	110,000	63,000	1,440	3
Xylenes (Total)	24,900	413,000	31,900	50,850	19,000	4,450
Isopropylbenzene	9,900	133,100	8,500	12,350	6,250	6,000

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from the concentrations in Table 1 that conductance would be a useful field screening tool for determining if groundwater is influenced by the PRRS inorganic plume.

Wells in and downgradient from the Ruetgers-Nease Plant area contain volatile organic compounds in significant levels. The total number of parameters and the concentration of these parameters varies somewhat. Wells 2629 through 2633 are enclosed in boxes on Figure 1 because they all contain average levels of ethylbenzene, toluene, total xylenes, and isopropylbenxene in excess of 1000 µg/L as is shown in Table 2. With the exception of Toluene, levels of 1000 µg/L were also exceeded in Well 2634 for each of the signature parameters shown in Table 2.

The PRRS installed additional wells after their first two sample rounds. In February 1991, while sampling Well 2701, the volatile vapors reached levels that required the sampling team to put on respirator protection. Data from the sample is not available as of yet; however, it is clear that there is a volatile organic plume well to the east of the Ruetgers-Nease property. All the groundwater contour data indicate that this plume is probably from an as-yet unidentified source because this is a location that is not downgradient from Ruetgers-Nease. There is also the possibility that some characteristic of the sediments in the area is causing the organic plume to migrate in a slightly different direction than the groundwater gradient. In either case, the presence of organic parameters in the vicinity of Well 2701 is a problem that severely impacts the placement of the removal action wells.

In a simplistic way, the current data provide three separate chemical signatures for the plumes. The FMPC plume is characterized by elevated total uranium with otherwise normal water chemistry. The Albright & Wilson plume contains elevated inorganic parameters, which in some wells includes uranium. The Ruetgers-Nease plume is characterized by four prominent volatile organic parameters.

The modeling effort presented in the South Plume EE/CA indicated that the zone of influence of the recovery wells would extend over the entire width of the buried valley. At the time the EE/CA was written there was no data available to indicate what the extent of contamination was under the PRRS area. The well design and pumping program presented in the EE/CA was a conceptual design that showed that four wells pumping at 500 gallons per minute would be sufficient to control the southern edge of the plume. WMCO took responsibility for the detailed design and installation of the system.

Investigation Goals

The purpose of this investigation is to determine the best location for the recovery wells and the optimum pumping rate for the wells so that they achieve the goals of the removal action and do not unduly influence the PRRS plumes.

Investigation

The principal parts to the investigation are to:

- Conduct field sampling to determine the boundaries between the three plumes.
- Compile Fernald and PRRS field data from 1991 on maps and figures that illustrate the extent of the three plumes.
- Conduct computer modeling to determine the optimal location and flow rates for the recovery wells.
- Present the model results as particle tracks and water table maps to illustrate the conclusions reached.

Conclusions of the investigation will include:

- Pumping well locations and screen lengths.
- Pumping rates for each well.
- Proposed locations for monitoring wells to assure that the pumping program is having the expected impact on the environment.
- Specifications for a sampling program to monitor the removal action using existing and new wells.

Field Investigation

The field program is designed to take advantage of the distinct character of the three plumes and the relatively simple geologic environment. Besides the use of conventional groundwater sampling in existing wells and piezometers, the geologic environment allows the use of the Hydropunch tool with a hollow stem auger drilling machine to collect many groundwater samples without installing permanent wells. The geologic environment is also ideal for conducting a soil vapor survey to determine the extent of the volatile organic plume.

Conventional Groundwater Sampling

Conventional groundwater samples will be collected by the WMCO Environmental Monitoring staff from the wells and piezometers listed in Table 3 and shown in Figure 2. The samples will be collected using standard procedures under the RI/FS QAPP. One sample will be collected from each sampling point and analyzed for total uranium in the WMCO Laboratory. Every tenth sample will be duplicated and the duplicate will be sent to the IT Laboratory for confirmatory analysis.
The conductance of each sample will be measured in the field. Samples with a conductance greater the 1000 μmohs/cm will be analyzed for the HSL metals. An HNu will be used to screen all samples. 6

TABLE 3

Wells and Piezometers to be Sampled by WMCO

Wells	Piezometers
2002	2541
2125	2542
2126	2543
2128	2544
2129	2545
2391	2546
2393	2547
2394	2548
2396	2549
2624	
2625	
2626	
2627	
2628	
2631	
2632	
2633	
2636	
3391	
3636	

If there is a sustained reading of greater than 5 ppm for at least 10 seconds, a VOC sample will be collected and analyzed for HSL volatile compounds.

Hydropunch Groundwater Sampling

The Hydropunch tool is designed to be driven into an aquifer to a predetermined depth and then opened to collect a groundwater sample at a specific depth. The tool is made of hardened steel and stainless steel so that all parts that come in contact with the sample are compatible with sampling equipment construction materials specifications in the RI/FS QAPP. The tool is a stainless steel sampling tube with one-way valves at the top and bottom. The tool collects a one liter sample.

In operation, the augers are advanced to a depth a few feet above the depth where the sample is to be taken. The Hydropunch, equipped with a hardened steel drive point, is driven into the aquifer ahead of the augers with a standard 140 pound hammer. When the Hydropunch is at the desired depth, it is back hammered about six inches. This reverse movement pulls the drive point from the bottom of the tool and opens the sampling port. Hydrostatic pressure forces water into the sample chamber. The Hydropunch then is withdrawn from the augers and the sample is transferred to the sample bottles. The Hydropunch is disassembled and decontaminated like a split spoon sampler between uses.

The Hydropunch technique has two distinct advantages for this investigation. First, since there is only an auger hole which is immediately filled and sealed, there is not the expense of installing and developing a well in order to collect a sample. Secondly, the Hydropunch can be used to collect successively deeper samples at a given location. This feature allows the vertical profile of the plume to be determined with a much greater degree of precision than with 2000- and 3000- series wells, where screens may be 50 to 80 feet apart vertically.

Figure 2 also shows the locations of two traverse lines where the Hydropunch will be used to collect water samples on 150-foot intervals at a depth of seven feet below the water table. The main Hydropunch effort will be along the preferred line for location of the recovery wells. A second short line will extend east from the Albright & Wilson Plant area to test for the presence of an inorganic plume.

The conductivity of each sample will be measured in the field. The samples then will be bottled and sent to the WMCO laboratory for total uranium analysis. There is not a sufficient volume of water collected from the Hydropunch to send a sample for HSL metals analysis as is done with the samples from the wells and piezometers. 8

As shown in Figure 2, there are several points along the Hydropunch traverses where three samples will be collected over a vertical profile. The first sample, like all the other locations, will be collected at a depth of seven feet below the water table so there is sufficient hydrostatic pressure to fill the sampler. The second sample will be taken at a depth of 20 feet below the water table and the third at a depth of 30 feet below the water table. In each case, the water table will be determined by measurement in the nearest well or piezometer.

These multiple sample points will provide information on the thickness of the uranium plume that cannot be gathered using the present monitoring well network. This vertical profiling will be used to determine proper depth and length of the removal well screens. It also will be used to determine the optimum depth of monitoring wells that will be used to measure the effectiveness of the removal action.

The vapors forced out of the augers when the Hydropunch is withdrawn will be monitored with an HNu. If the vapors provide a reading of 5 ppm or greater for at least 10 seconds, a second sample will be collected from the same depth for HSL volatilc organic analysis.

Soil Vapor Sampling

It is not the job of the FMPC RI/FS to define the extent of the volatile organic plume associated with the PRRS site or any other site in the area. It is, however, important to the removal action to know the northern and eastern extent of the volatile organic plume, so the pumping wells do not cause the organic material to move toward them.

The geologic environment is conducive to using a soil vapor survey to delineate the organic plume with a relatively high degree of certainty at very low cost. Unlike the FMPC property, there is no clay rich glacial overburden over the aquifer in this part of the south plume investigation area. The volatile organic materials are all lighter than water, so they are migrating on the top of the water table. Relatively permeable alluvial deposits from the Great Miami River exist between the aquifer and the surface. Vapors should tend to migrate upward in these sediments rather than laterally under more clay rich materials. The main factor that will limit the effectiveness of the survey is the very high moisture content of the soils due to the wet weather. Generally, the higher the soil moisture content is, the lower the permeability with respect to organic vapors.

A semiquantitative soil vapor survey can be conducted with simple hand-held tools transported on a small four-wheel all-terrain vehicle which will result in minimum impact on private property. The 9 survey consists of driving a one-inch diameter drill to a depth of 30 inches with an electric percussion hammer. A portable generator located a distance from the sample site is used to power the hammer via a long extension cord. A probe is inserted into the hole and attached to a Foxboro 126 Organic Vapor Analyzer (OVA) which has been calibrated to a methane standard. Soil vapor is drawn through the OVA and a reading is made which gives a value in methane equivalents. This analytical device will provide a semiquantitative measure of the extent of the volatile organic plume.

As indicated in Figure 2, the shaded area east of Ruetgers-Nease is the 200-foot-wide by 1300-foot-long area where a soil vapor survey will be conducted. This area is north and east of the known occurrence of volatile organic contamination and is in an area where several homes and businesses are located. Soil vapor readings will be taken on a grid with 100-foot centers within the shaded area. If readings drop off dramatically between any two 100-foot stations, an additional reading half way between the two stations will be taken to refine the boundary of the plume. Data from the soil vapor survey will be plotted on maps to determine the extent of the volatile organic plume.

Groundwater Modeling

A meeting was held in Dayton, Ohio on February 20, 1991, by OEPA and DOE regarding the installation of the South Plume Removal Action wells. Their potential impact on the groundwater plume observed beneath the Ruetgers-Nease Chemical Corp. and south of New Haven Road was discussed. Several questions were raised during the meeting regarding the locations and pumping rates proposed for these wells. Issues were further defined in a meeting with DOE and WMCO on March 4, 1991, at the RI/FS site office.

We propose to investigate the possibility of modifying the locations and designs of the recovery wells and to better define the organic plume boundary. The following actions will be taken to resolve the issues dealing with the removal action wells:

1. Groundwater modeling to determine the following:

    - If the removal action wells can be moved further north without affecting their capture of the uranium plume.
    - If the removal action wells can be replaced with more wells which are grouped closer and have a lower combined pumping rate than the presently proposed wells.
    - If the pumping rates of the wells can be modified to pump less from the west side and more from the east to allow less impact on the organic plume associated with the Paddys Run Road site.

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- The locations, sizes, and pumping rates for the removal action wells based on the above investigations.

2. Updating the groundwater modeling to utilize the latest model calibration with the retardation equal to 12 for uranium.

3. Production of maps showing both DOE and Paddys Run Road Site RI/FS wells and their organic compound and uranium data.

4. Determine what data gaps exist and how to fill them by:

   - Analyzing if additional well installations and sampling are necessary.

   - Recommending, if necessary, additional locations of monitoring wells and how they are to be sampled and analyzed.

Groundwater modeling and geochemical data evaluation will be conducted at the Pittsburgh office. Final results of these investigations are expected to be ready three weeks following approval for initiating work. The results of this task will be presented in a summary report and in two meetings to be held with DOE, U.S. EPA, and OEPA in Fernald, Ohio. The report will be issued two weeks after the meetings are held with DOE and the agencies.

Schedule

Field work will begin when notification is received from DOE that landowner permissions have been secured. The field work will take one month.

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